Results from Water Quality Monitoring Conducted during Project AWARE 2015 on the Wapsipinicon River in East-Central Iowa

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Abstract: From July 11-16, 2015, 433 volunteers participated in Project AWARE 2015, the Iowa Department of Natural Resources volunteer river cleanup. The 2015 event was held on the Wapsipinicon River in east-central Iowa. Project AWARE, which stands for **A W**atershed **A**wareness **R**iver **E**xpedition, is a five-day, five-night canoe trip down an Iowa river that allows volunteers to participate in a river cleanup, water quality monitoring, and on-river and evening educational programs. This was the thirteenth year of the event. A total of 30.1 tons of trash was removed from 63 miles of the Wapsipinicon River. Ninety-one percent of the trash was recycled, which included 14.6 tons of scrap metal and 10.4 tons of tires. Project AWARE is an initiative of the Iowa Department of Natural Resources IOWATER and Water Trails programs. The event was made possible through the financial and in-kind support of the Iowa Department of Natural Resources and 89 sponsors.

In addition to trash removal, 22 stream sites along the canoe route were monitored for a variety of water quality parameters using IOWATER methods. IOWATER is Iowa's volunteer water monitoring program. This report summarizes the water quality results for sites monitored during Project AWARE 2015. For more information on Project AWARE, go to *www.iowadnr.gov/aware*.

Introduction

Project AWARE, which stands for **A W**atershed **A**wareness **R**iver **E**xpedition, is the Iowa Department of Natural Resources' volunteer river cleanup event during which hundreds of Iowans spend anywhere from a day to several days improving Iowa's waterways by removing trash. While the main goal of Project AWARE is to bring Iowans together in a civic engagement project that provides them with an opportunity to experience and enhance their state's rivers from the seat of a canoe, Project AWARE volunteers also have opportunities to participate in educational opportunities, collect and analyze water quality monitoring data, and develop healthy behaviors that help benefit the environment.

Project AWARE 2015 represents the 13th year of this annual event. Previous Project AWARE events have paddled and cleaned up stretches of the Maquoketa River in northeast Iowa; the Des Moines River watershed in north-central Iowa; the Little Sioux River in northwest Iowa; the Iowa and English rivers in southeast Iowa; the Middle and North Raccoon rivers in west-central Iowa; the Winnebago, Shell Rock, and the upper Cedar rivers in northeastern Iowa; the middle Cedar River in eastern Iowa; the East and West Nishnabotna rivers in southwest Iowa; the Little Turkey, Turkey, and Volga rivers in northeast Iowa; the Iowa River in north-central Iowa; the Des Moines River and Boone River in north-central Iowa; and the Big Sioux River in northwest Iowa (Figure 1).

In 2015, 433 people participated in Project AWARE. Volunteers ranged in age from <1 to 76 and averaged 225 volunteers on the water per day. In 2015, 52% of the volunteers were first-year participants, while 24% had been on Project AWARE five or more years. A total of thirteen volunteers were recognized for being on Project AWARE ten years. In addition to Iowa, volunteers were from Arkansas, Colorado, Illinois, Kansas, Minnesota, Missouri, Nebraska, South Dakota, Washington, and Wisconsin. Also, two volunteers were from China and Sweden.

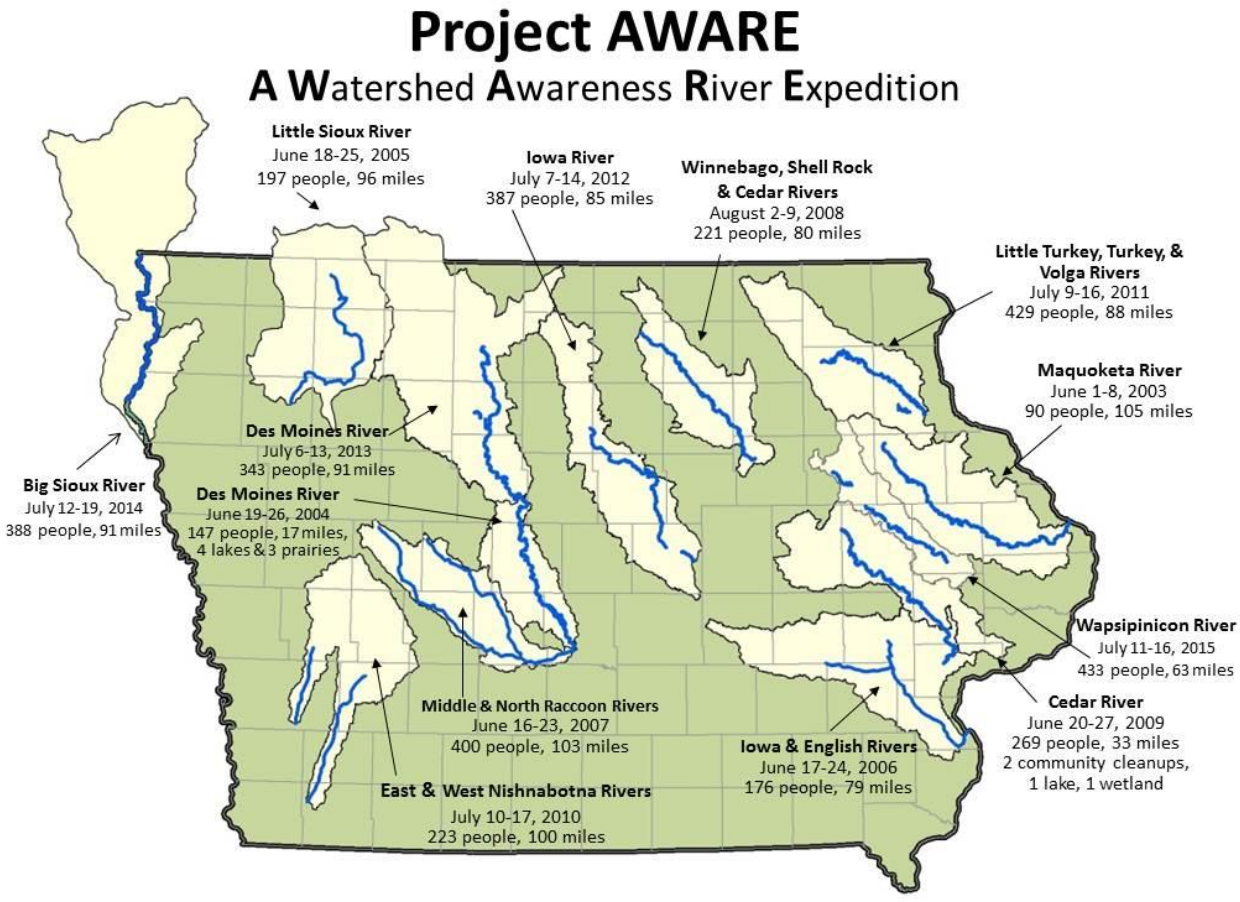

Figure 1. Location of Project AWARE events from 2003 through 2015.

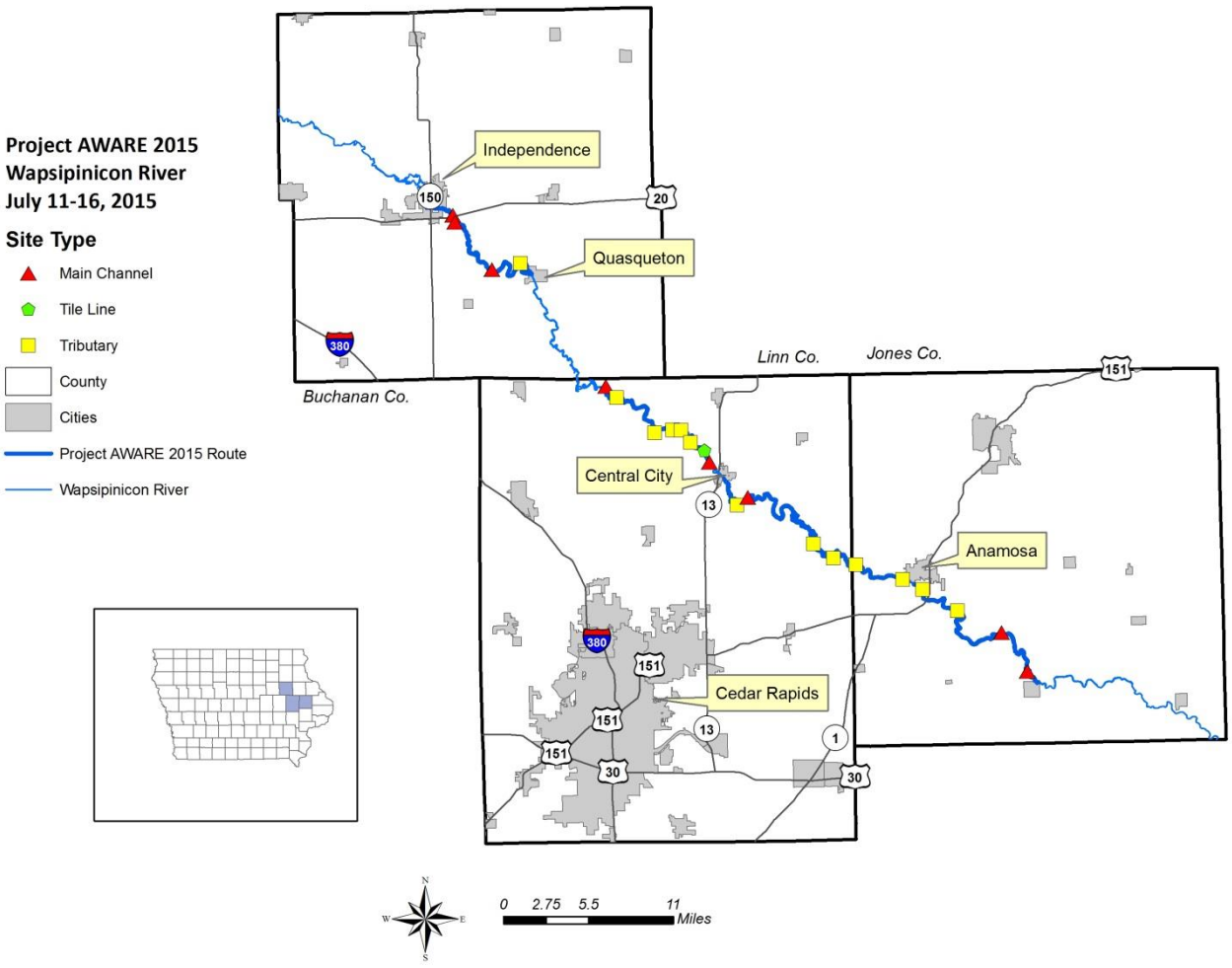

Figure 2. Location of sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Project AWARE water quality monitoring was conducted by the following volunteers – Robin Fortney and Jodi Kallevang on Sunday July 12, Mary and David Koester on Monday July 13, Teagan DiSalvo, Danilea McKee, and the Maas family on Tuesday July 14, and Chuck Tonelli and the Metro High School participants on Wednesday July 15 and Thursday July 16. Prior to the event, potential monitoring sites were identified by Project AWARE staff. Sites were selected based on starting, half-way, and take-out points for each day of Project AWARE, location of major tributaries entering the Wapsipinicon River, and other locations of interest. A total of 22 sites were sampled (Figure 2). Results are available in Appendix A.

For all sites sampled during Project AWARE 2015, water quality data were collected using IOWATER field methods as described in the IOWATER Quality Assurance Project Plan (2010). Field data were recorded on waterproof paper field sheets. This report summarizes the water quality from the Project AWARE 2015 sampling of 22 sites (Figure 2) and includes the chemical and physical results (Table 1).

Where possible, water quality results from Project AWARE were compared to a network of 60 streams statewide that is monitored on a monthly basis as part of the Iowa Department of Natural Resources' (DNR) Water Quality Monitoring and Assessment Ambient Stream Monitoring Program. Data from this network have been collected since 2000 and provide perspective on typical stream concentrations statewide for the various parameters (Iowa DNR, April 2015). In this report, this statewide stream network will be referred to as the DNR statewide stream network. The July 2015 data from the DNR statewide stream network were compared to Project AWARE results to give an idea of the relative concentrations of various parameters in streams statewide during the same time period.

Table 1. Monitoring results from Project AWARE 2015.

	Unit	Method	# of samples	Min Value	Percentiles			Max Value
					25th	50th	75th	
Chloride	mg/L	IOWATER test strip	21	<31	<31	<31	<31	50
Dissolved Oxygen	mg/L	IOWATER field kit	22	6	8	10	12	12
Nitrite-N	mg/L	IOWATER test strip	22	0	0	0	0	0.15
Nitrate-N	mg/L	IOWATER test strip	22	1	5	10	10	10
Phosphate	mg/L	IOWATER field kit	22	0	0	0	0.2	0.6
pH	pH units	IOWATER test strip	22	7	9	9	9	9
Temperature, Air	degrees F	Thermometer - Field	22	64	75	79	85	96
Temperature, Water	degrees F	Thermometer - Field	22	60	73	74	77	84
Transparency	centimeters	IOWATER transparency tube	20	12	24	27	39	60

mg/L = milligrams per liter (or parts per million - ppm)
F = Fahrenheit

Precipitation and Stream Flow Conditions

For the days of Project AWARE, water levels for the Wapsipinicon River were slightly below the long-term normal conditions based on U.S Geological Survey data (Figure 3). Stream flow for the Wapsipinicon River at Independence varied from 381 to 561 cubic feet per second (cfs) during Project AWARE. The drainage area for the Wapsipinicon River at Independence, Iowa, is 1,048 mi^2. Stream flow for the Wapsipinicon River at Anamosa (drainage area of 1,575 mi^2) varied from 797 to 1,090 cfs. Stream flow levels were highest on July 11 and declined through July 16. Water levels for the Wapsipinicon River at Independence were 59 to 72% of the long-term normal for this time of year, while stream flow for the Wapsipinicon River at Anamosa was 41 to 56% of the long-term normal.

Air temperatures for the week of Project AWARE were near normal. Temperatures ranged from highs of 76 to 92 degrees Fahrenheit to lows of 55 to 68 based on the Anamosa, Iowa, climate station (https://mesonet.agron.iastate.edu/). Normal highs for this time of year are 84 to 85 degrees Fahrenheit with lows of 60 to 61. Rain fell twice during Project AWARE. The Anamosa climate station recorded 0.12 inches on July 12 and 0.14 inches on July 16 (https://mesonet.agron.iastate.edu/).

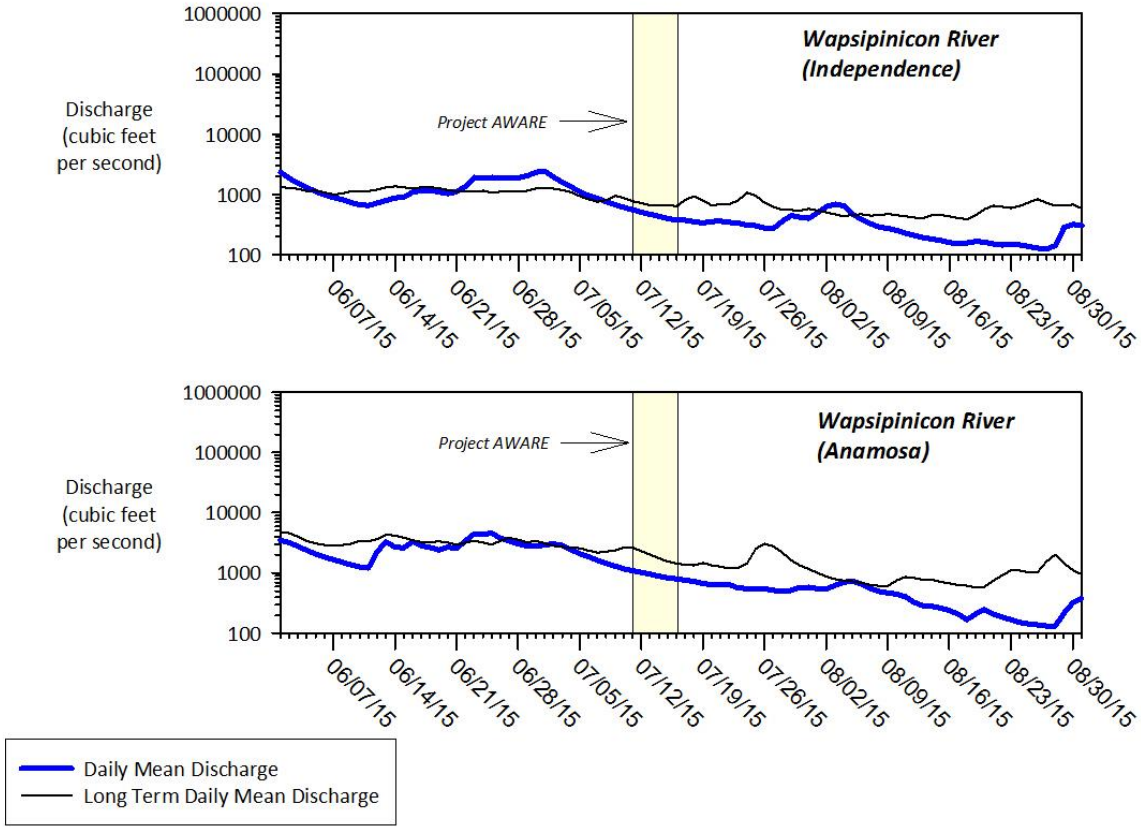

Figure 3. Discharge for the Wapsipinicon River for June 1, 2015 through August 31, 2015. The yellow shaded area represents when Project AWARE occurred July 11-16, 2015. Data are from http://ia.water.usgs.gov.

Chemical and Physical Parameters

Water Temperature

Water temperature affects many of the biological, chemical, and physical processes in a stream, including the amount of oxygen gas that can dissolve in water, the rate of photosynthesis by algae and plants, as well as the metabolic rate of aquatic animals.

Water temperature was measured at 22 sites and temperatures varied from 60 to 84 degrees Fahrenheit (F) (Table 1; Figure 4). Water temperatures on the main stem of the Wapsipinicon River were similar compared to the tributary sites (median of 74 for both). Water temperatures for the tributary sites were more variable than the main stem sites.

Figure 5 compares the results of selected parameters from Project AWARE to the DNR statewide stream network. The median water temperature for sites monitored on Project AWARE was warmer (74 degrees F) than streams statewide (71 degrees F).

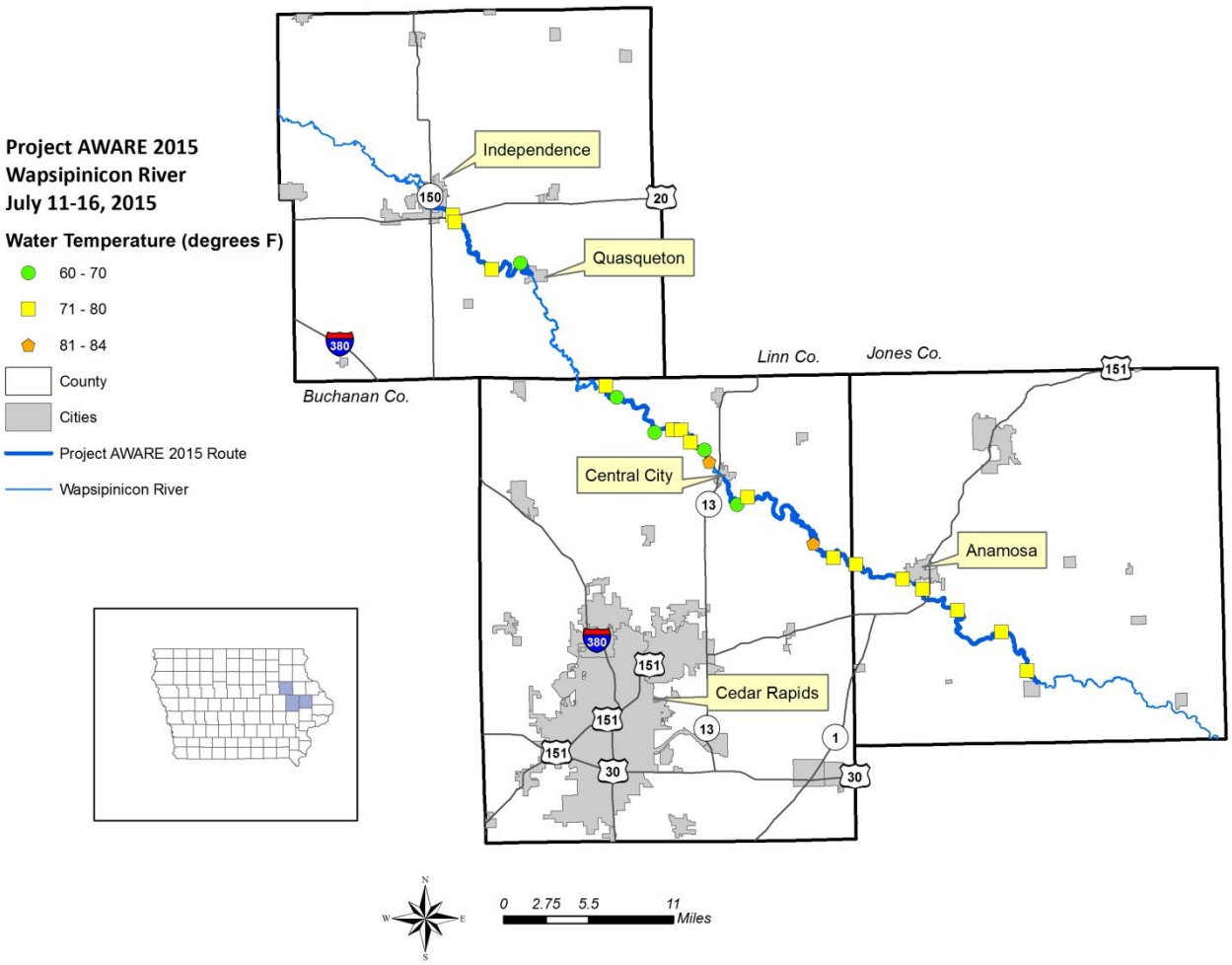

Figure 4. Water temperature (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

pH

pH is a measure of water's acid/base content. Changes in pH can be caused by atmospheric deposition of acid rain, the types of soils and bedrock that the water comes in contact with, wastewater discharges, and acid mine drainage. A pH of 7 is neutral; pH values greater than 7 are alkaline or basic, while a pH less than 7 is acidic.

pH levels for sites sampled during Project AWARE ranged from 7 to 9 using the IOWATER test strip (Table 1; Figure 6). The pH levels measured at sites sampled as part of Project AWARE were more variable than those measured as part of the DNR statewide stream network for July 2015 (Figure 5). The overall difference in pH values most likely has to do with a difference in pH methods. For Project AWARE, pH test strips were used which measure pH in whole number increments whereas for the DNR statewide stream network, calibrated pH meters are used that measure in tenths. Below normal stream flow conditions may have resulted in more baseflow input and therefore higher pH levels for the Project AWARE sites than the DNR statewide stream network.

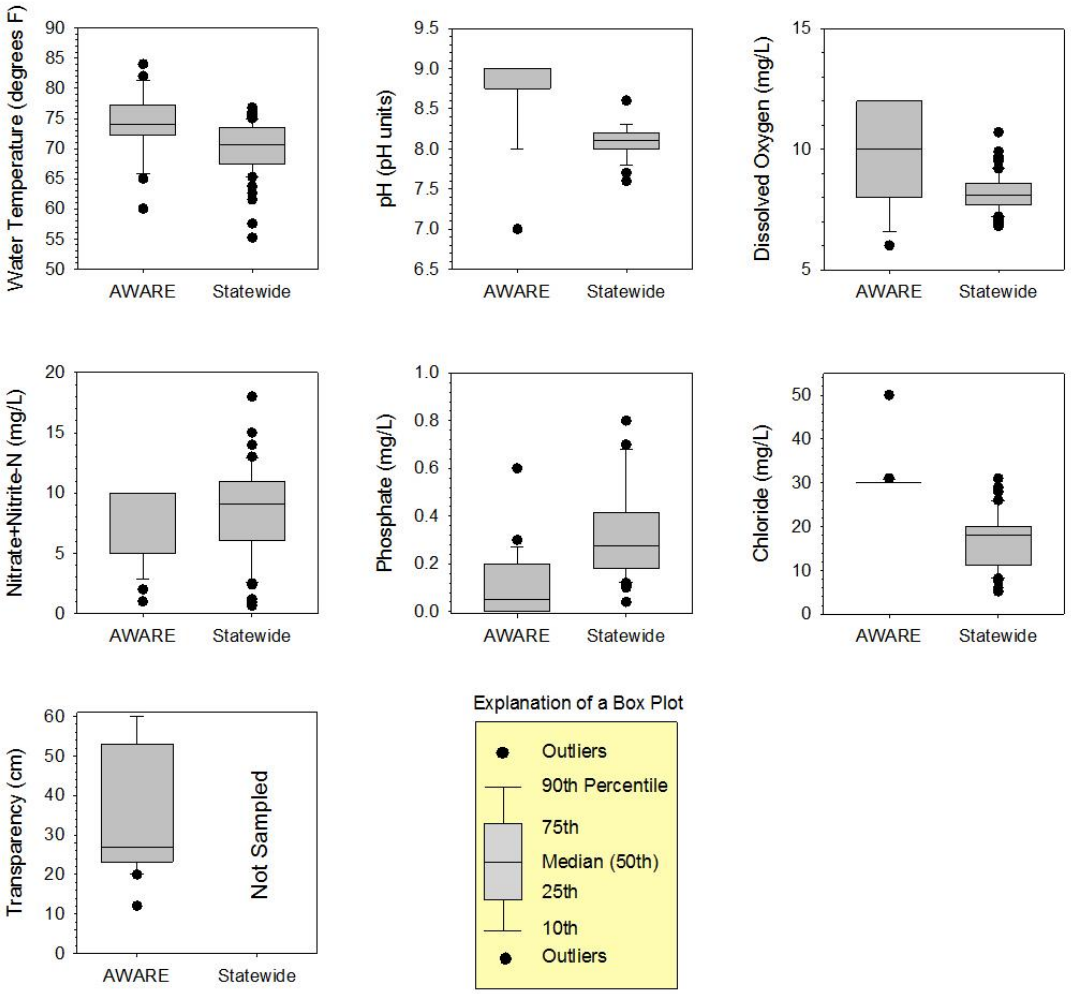

Figure 5. Box plots comparing water quality results for sites sampled during Project AWARE 2015 to the DNR statewide stream network for July 2015.

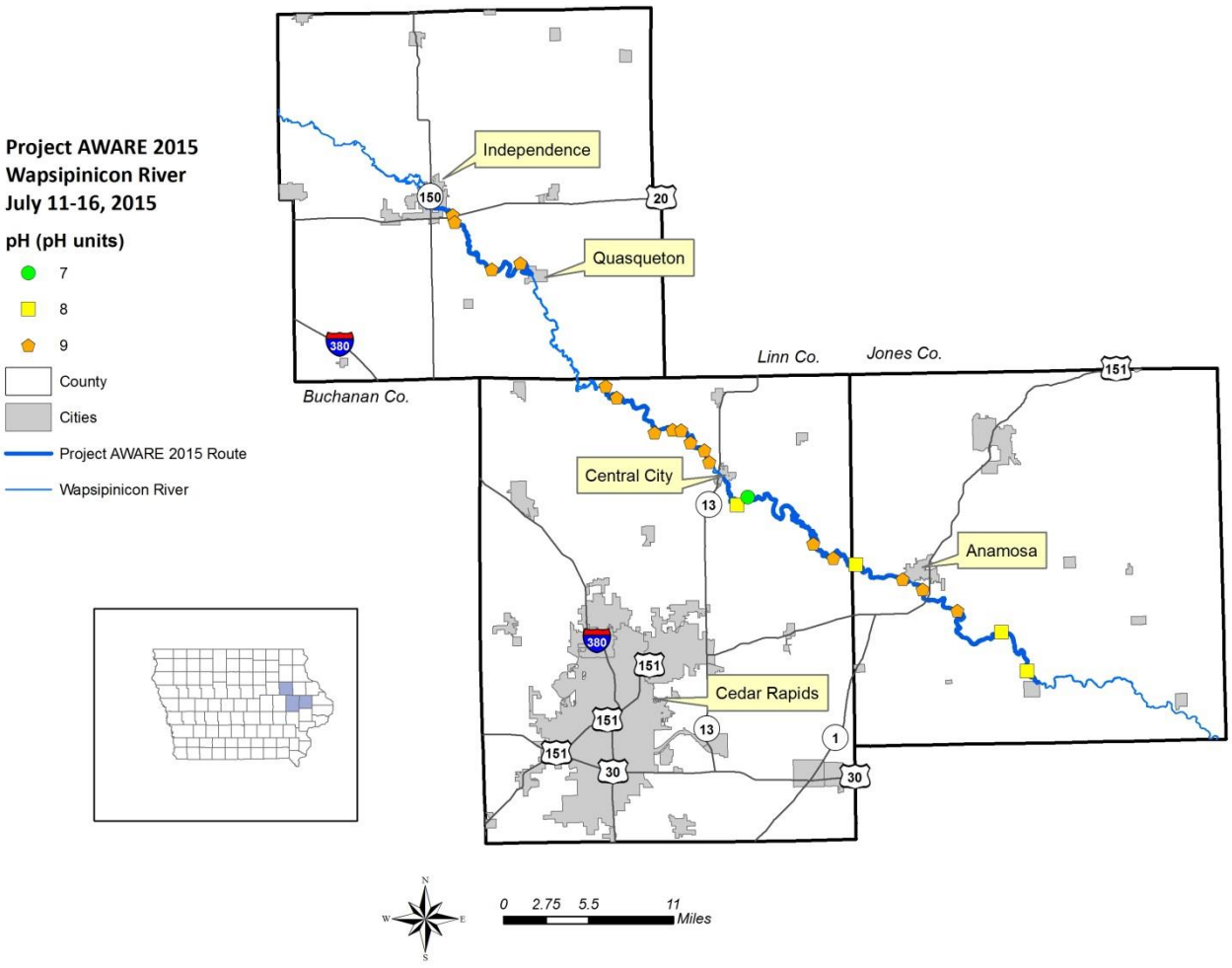

Figure 6. pH (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in water. As more material is suspended in water, less light can pass through the water, making it less transparent (or more turbid). These materials include soil, algae, plankton, and microbes.

Transparency ranged from 12 to 60 centimeters (cm) for all Project AWARE sites with a median of 27 (Table 1; Figure 7). Transparency was higher for the tributary sites (median of 30 cm) relative to sites on the main stem of the Wapsipinicon River (median of 26 cm). Four of the tributary sites had transparency readings of 60 centimeters, the upper limit, while the highest transparency for the main stem of the Wapsipinicon River was 30 centimeters.

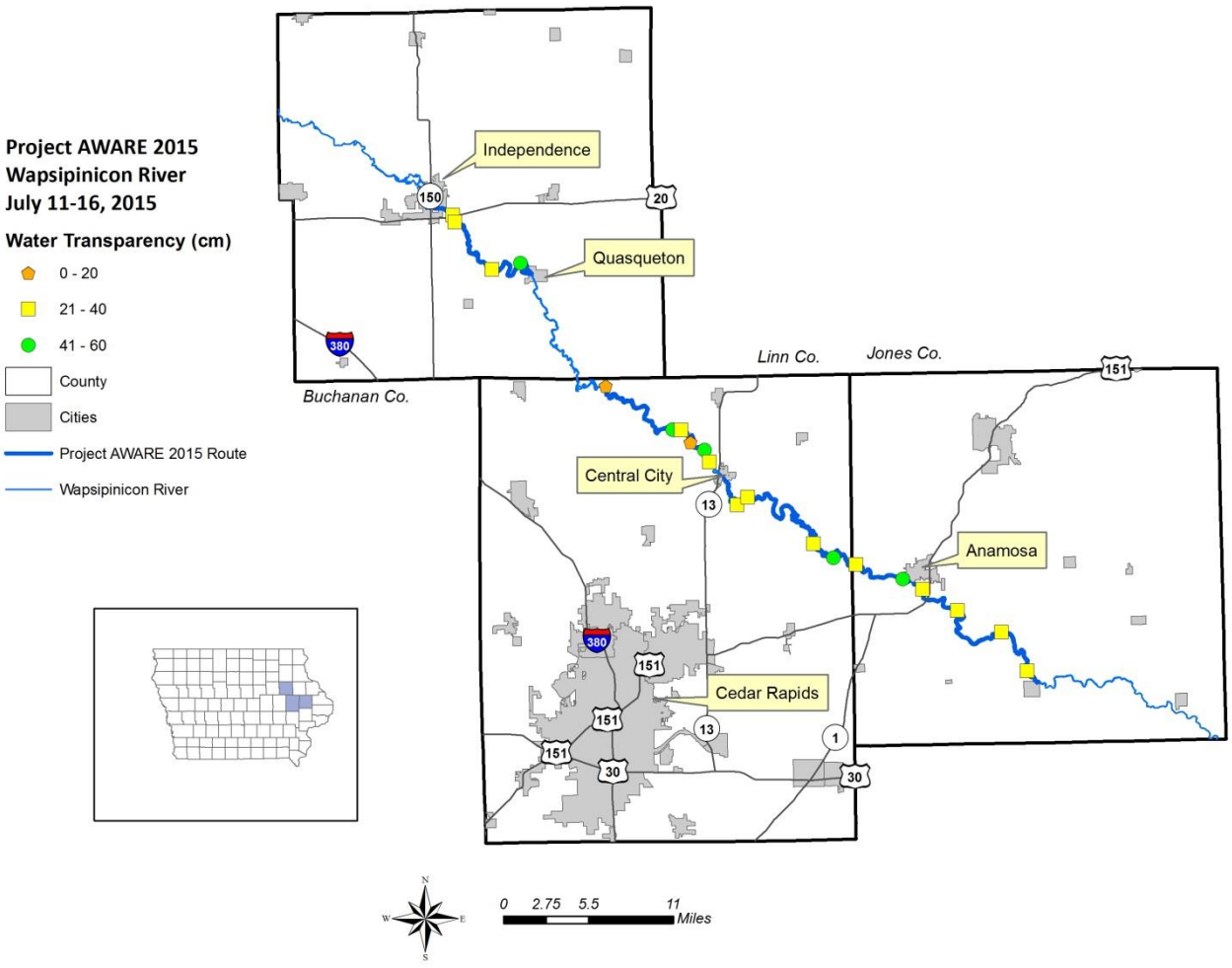

Figure 7. Water transparency (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Dissolved Oxygen

Dissolved oxygen levels in a stream can be affected by a number of variables, including water temperature, season of the year, time of day, stream flow, presence of aquatic plants, dissolved or suspended solids, and human impacts. Oxygen enters a stream through diffusion from the surrounding air and as a product of photosynthesis from aquatic plants. Oxygen in a stream can be consumed through respiration by aquatic plants and animals, and by the decomposition of organic matter. Iowa has a water quality standard minimum of 5 mg/L of dissolved oxygen for warm water streams.

For Project AWARE sites, dissolved oxygen ranged from 6 to 12 mg/L (Table 1; Figure 8) with a median of 10 mg/L. None of the sites had dissolved oxygen levels less than 5 mg/L which is Iowa's statewide standard for warm water streams. Dissolved oxygen concentrations measured during Project AWARE were slightly higher than levels measured in streams statewide for July 2015 (Figure 5).

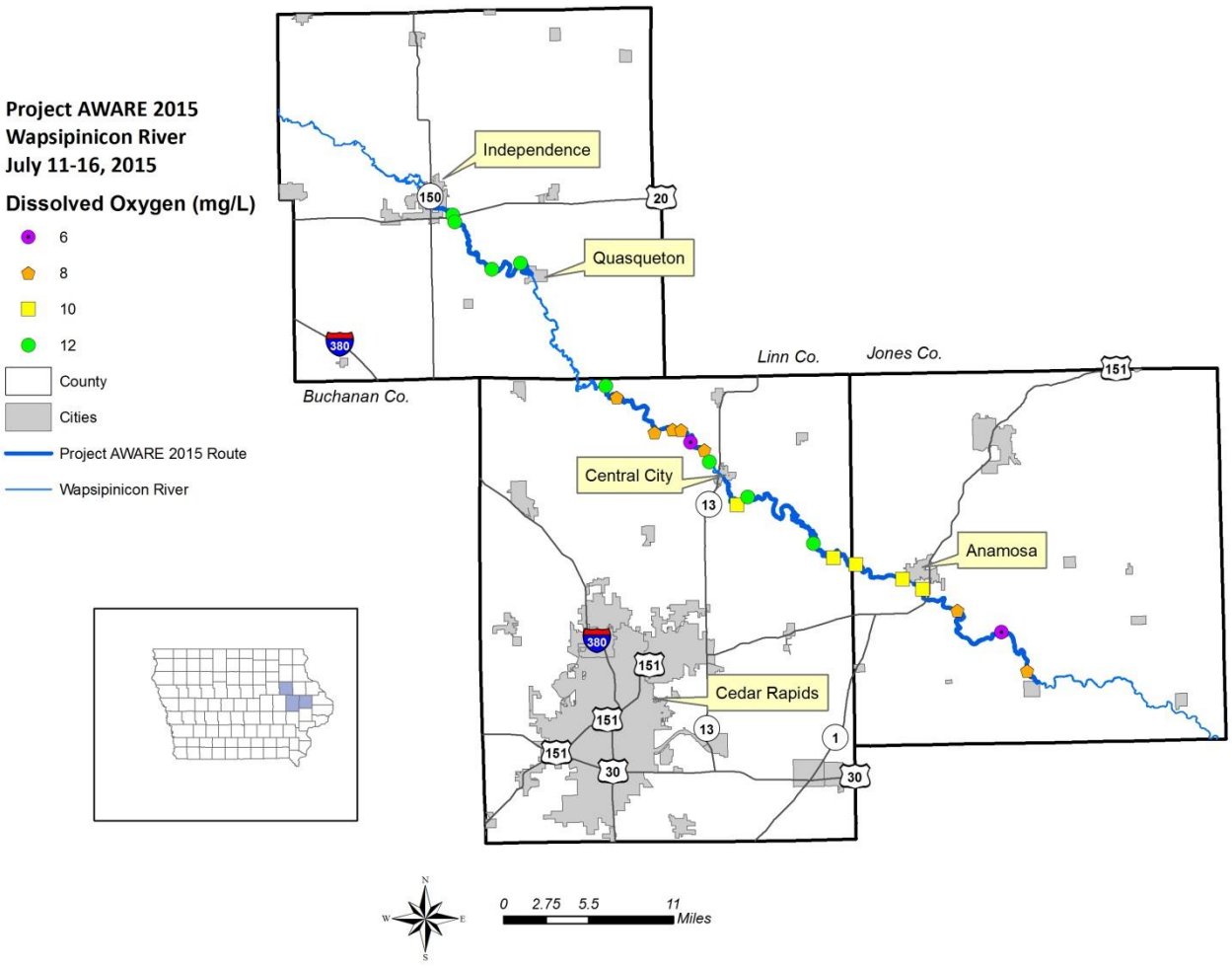

Figure 8. Dissolved oxygen (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Nitrite-N and Nitrate-N

Nitrogen is a necessary nutrient for plant growth, and includes both nitrite- and nitrate-nitrogen. Too much nitrogen in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that live in a stream. Sources of nitrogen include soils; human and animal wastes; decomposing plants; and fertilizer runoff from golf courses, lawns, and cropland. Typical nitrate+nitrite-N concentrations for Iowa streams range from 2.6 to 7.9 mg/L (Iowa DNR, 2015), with higher concentrations generally occurring in the late spring/early summer. Nitrite-N and nitrate-N are not measured separately as part of the DNR statewide stream network, rather it is measured and reported as nitrate+nitrite-N.

Nitrite-N was measured at Project AWARE sites using the IOWATER method (Table 1; Figure 9). Concentrations ranged from 0 to 0.15 mg/L. Just one site, located on the main stem of the Wapsipinicon River downstream of Central City, had a nitrite-N detection of 0.15 mg/L.

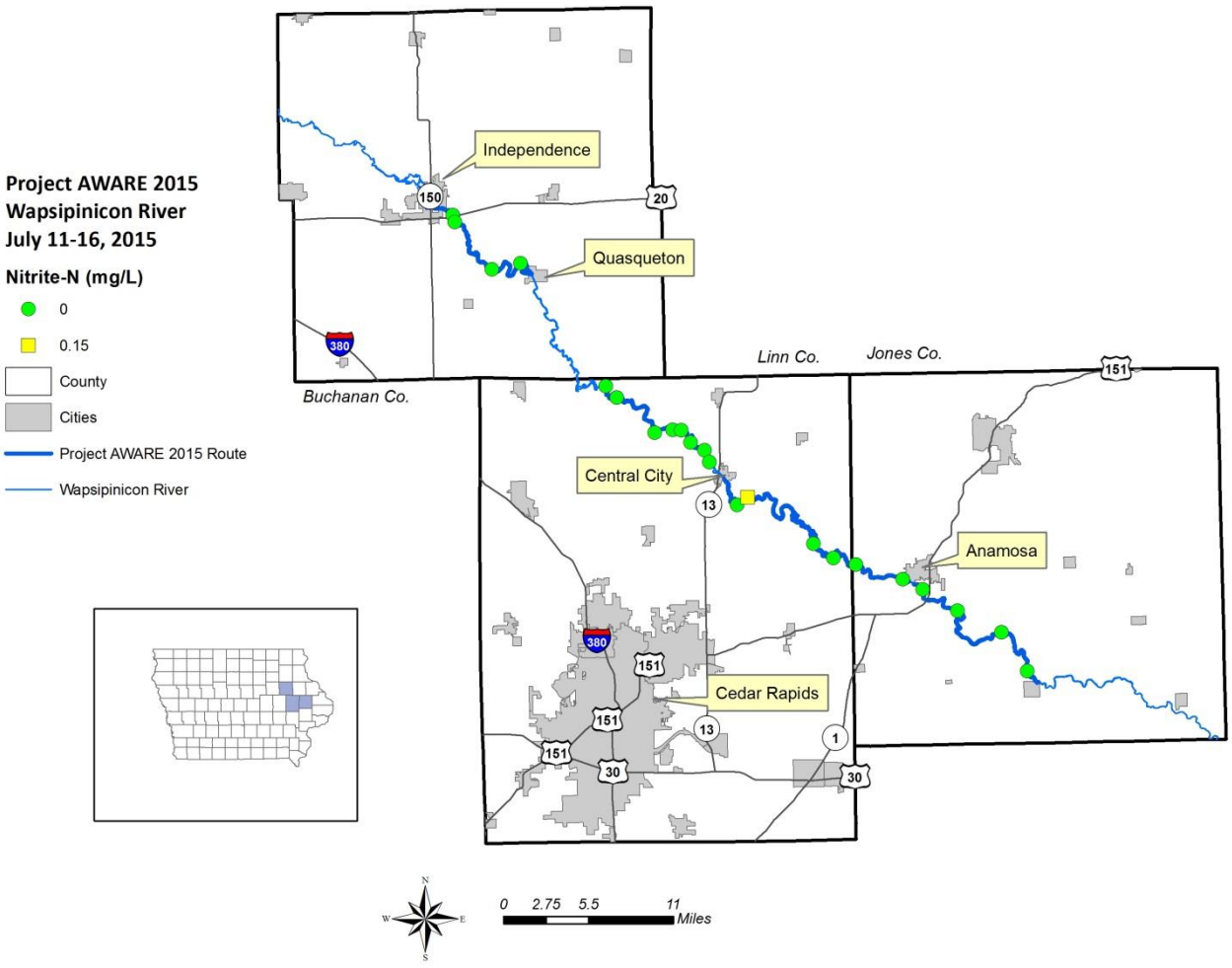

Figure 9. Nitrite-N (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Nitrate-N for sites sampled ranged from 1 to 10 mg/L (median of 10 mg/L; Table 1; Figure 10). The median nitrate-N for tributary sites was lower (5 mg/L) compared to sites on the Wapsipinicon River (10 mg/L). Sixty-four percent of the sites had nitrate-N concentrations of 10 mg/L. Nitrate-N results from Project AWARE sites showed a slightly higher median concentration (10 mg/L) than streams statewide (9.1 mg/L) yet a smaller range in concentration (Figure 5).

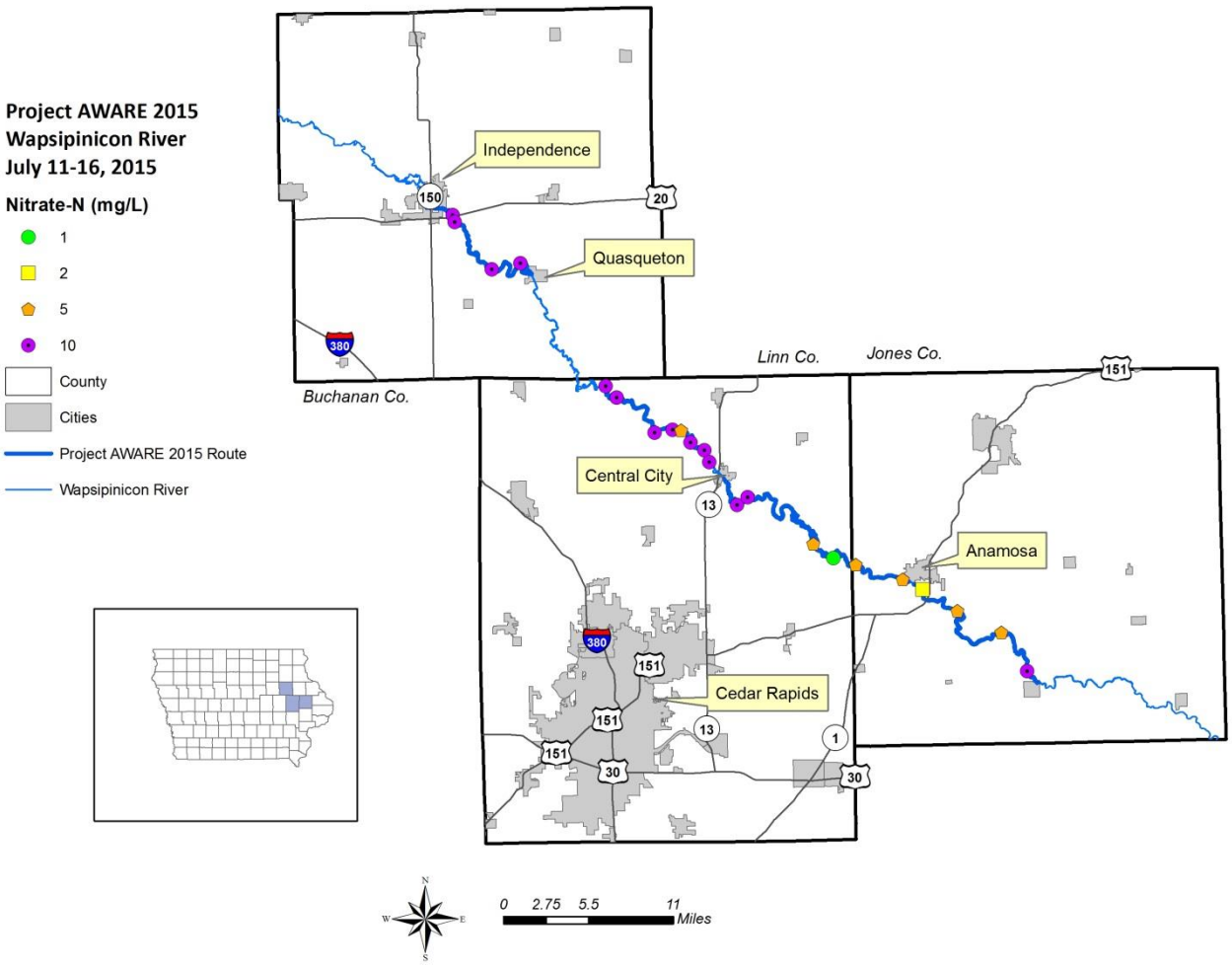

Figure 10. Nitrate-N (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Phosphorus

Phosphorus is a necessary nutrient for plant growth. Too much phosphorus in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth, and changing the types of plants and animals that live in a stream. Sources of phosphorus include certain soils and bedrock; human and animal wastes; detergents; decomposing plants; and runoff from fertilized lawns and cropland. Typical concentrations of phosphate in streams statewide vary from 0.11 to 0.32 mg/L, with a median of 0.19 mg/L (Iowa DNR, 2015).

IOWATER phosphate results for the Project AWARE sites ranged from 0 to 0.6 mg/L, with a median of 0.1 mg/L (Table 1; Figure 11). The highest phosphate level (0.6 mg/L) occurred at an unnamed tributary in Linn County. None of the other water quality results were unusual for this site. Phosphate concentrations for sites monitored as part of Project AWARE were significantly lower compared to streams statewide (Figure 5).

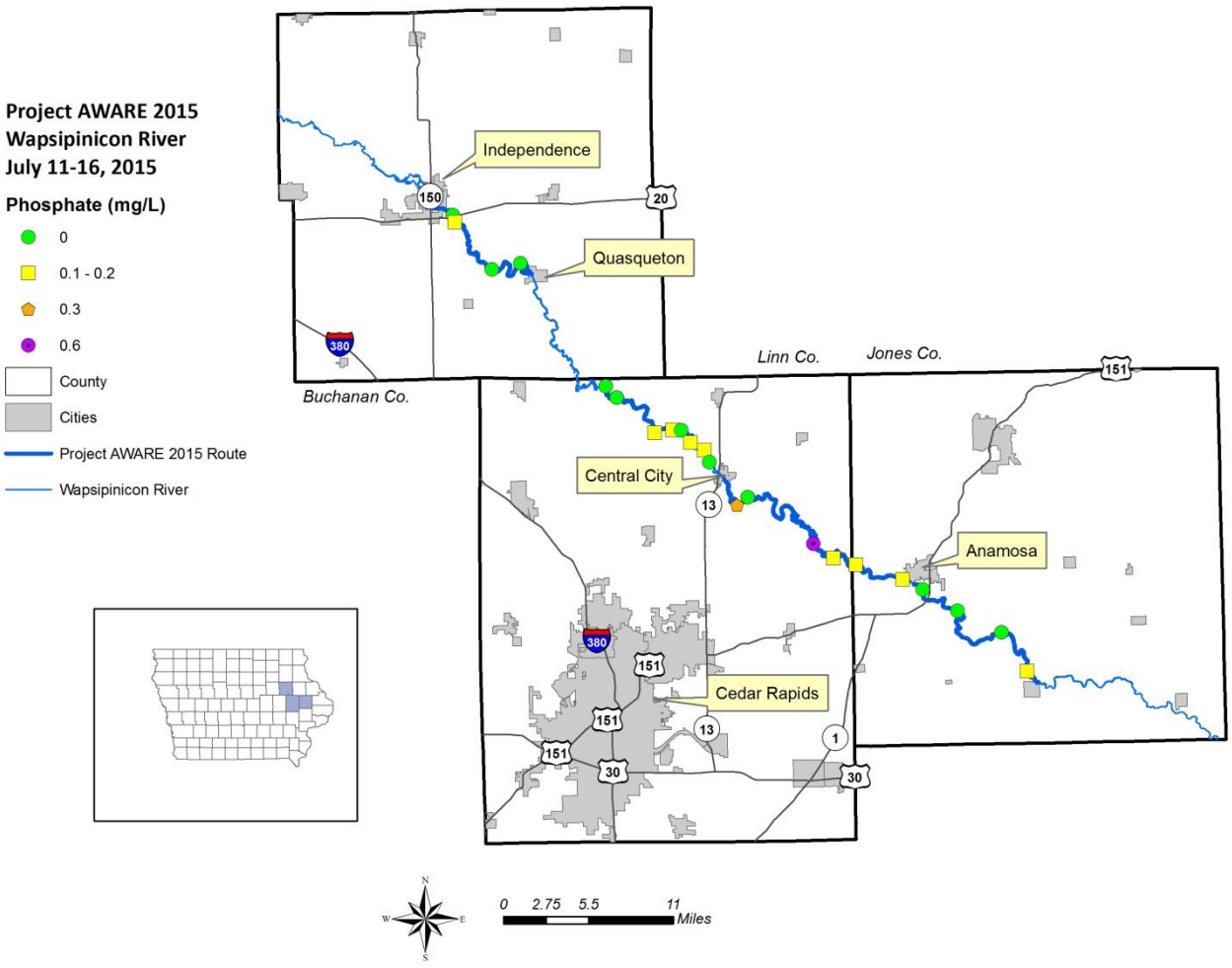

Figure 11. Phosphate (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Chloride

Chloride is a component of salt and is a measure of human or animal waste inputs to a stream. Potential sources of chloride to a stream include direct input from livestock, septic system inputs, and/or discharge from municipal wastewater facilities. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff to nearby streams. Typical concentrations of chloride in Iowa streams range from 16 to 29 mg/L, with a median of 22 mg/L, with higher concentrations occurring during winter months (Iowa DNR, 2015).

For Project AWARE sites, all but one of the chloride concentrations was at or below the test strip detection limit of 31 mg/L (Table 1; Figure 12). The highest chloride measured was 50 mg/L measured at an Unnamed Creek site in Linn County. None of the other results for this site were unusually high.

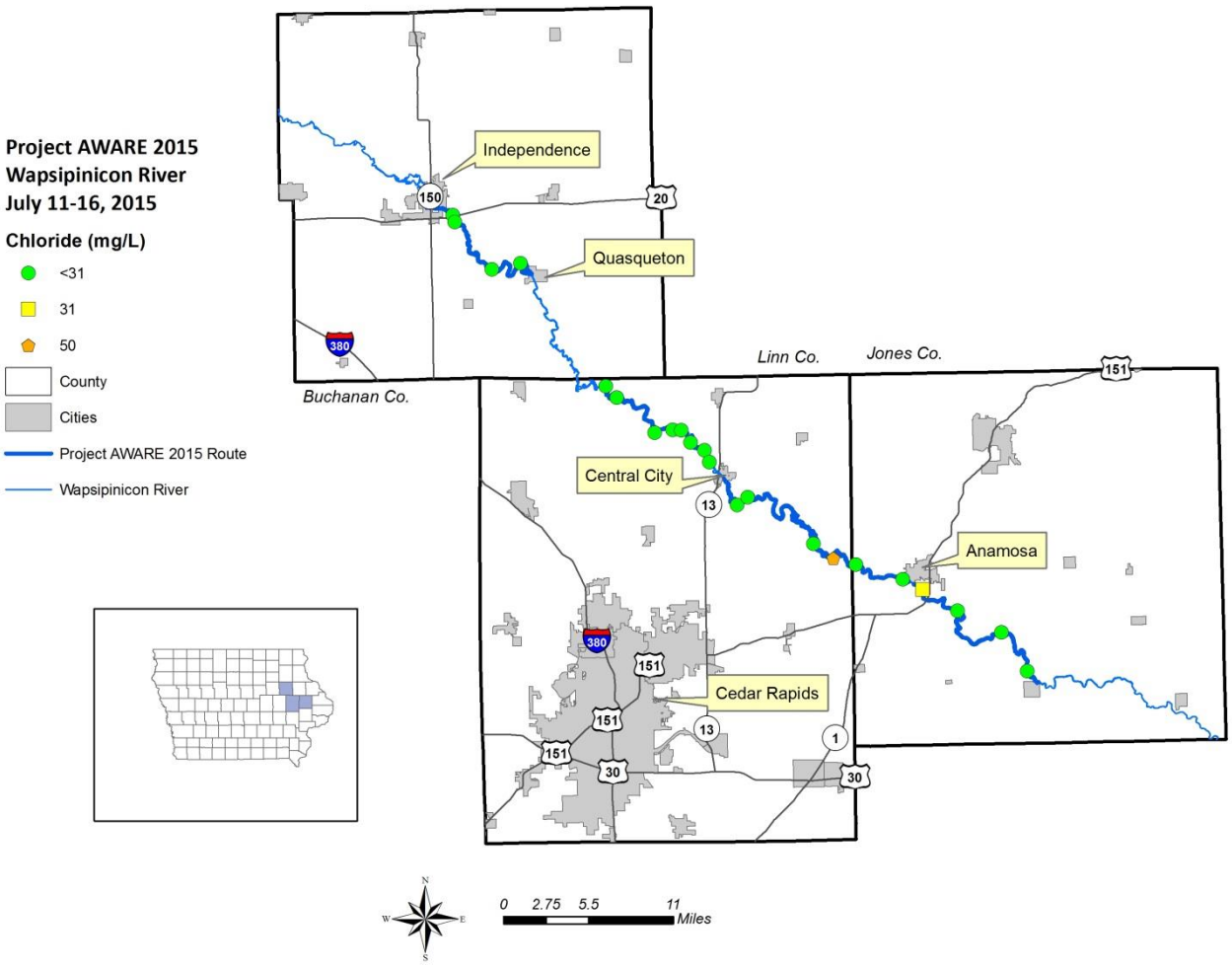

Figure 12. Chloride (IOWATER method) for sites sampled as part of Project AWARE 2015 on the Wapsipinicon River in east-central Iowa.

Summary

Through the efforts of 433 volunteers, a total of 30 tons of trash was removed from the Wapsipinicon River as part of Project AWARE 2015. A total of 22 sites were monitored for a variety of field parameters using IOWATER methods. Below are some observations from the data.

- Project AWARE occurred July 11-16, 2015, as Wapsipinicon River stream levels were below normal for this time of year. During the Project AWARE event, stream flows were 59 to 72% of normal for the Wapsipinicon River at Independence, and 41 to 56% of normal for the Wapsipinicon River at Anamosa.
- Water temperature for Project AWARE sites sampled ranged from 60 to 84 degrees Fahrenheit. Temperatures were similar for sites on the main stem of the Wapsipinicon River compared to temperatures for the tributary streams. Temperatures were slightly higher for Project AWARE sites compared to streams statewide during the month of July.
- pH ranged from 7 to 9. pH values for Project AWARE were more variable than levels measured for streams statewide and likely are caused by a difference in how pH was measured.
- Transparency ranged from 12 to 60 centimeters with a median of 27 cm. Transparency was higher for the tributary sites compared to the main stem sites.

- Dissolved oxygen concentrations varied from 6 to 12 mg/L with a median of 10 mg/L. All of the measured oxygen levels were above Iowa's statewide standard for warm water streams of 5 mg/L.
- Nitrite-N concentrations ranged from 0 to 0.15 mg/L with all but one site measuring no detectable level of nitrite-N.
- Nitrate-N concentrations ranged from 1 to 10 mg/L. The median nitrate-N for tributary sites was lower (5 mg/L) than for sites on the Wapsipinicon River (10 mg/L).
- Phosphate ranged from 0 to 0.6 mg/L, with a median concentration of 0.1 mg/L. Levels measured during Project AWARE were lower compared to levels in streams statewide for July 2015.
- The majority of chloride concentrations (95%) were at or below the test strip detection limit of 31 mg/L. The low chloride suggests that the sites monitored were not directly impacted by any point source inputs. Chloride levels were higher for Project AWARE sites compared to the DNR statewide stream network due to a difference in the detection limit associated with the method used for each of the monitoring efforts.

Acknowledgements

Sincere thanks to Robin Fortney, Jodi Kallevang, Mary and David Koester, Teagan DiSalvo, Danilea McKee, the Maas family, and Chuck Tonelli and the Metro High School students for conducting the water quality monitoring throughout the week of Project AWARE 2015. The Project AWARE monitoring and site selection efforts were coordinated by Rebecca Kauten. Project AWARE staff provided review of the report.

References

Iowa Department of Natural Resources, Stream Water Quality Summary 2000-2014, April 2015, 2 p.

IOWATER Quality Assurance Project Plan. 2010. Iowa Department of Natural Resources. QA/WM/01-02. 94 p.

Appendix A. Water quality results.

Site_No	Site_Name	Site_Type	Sample_Date	UTMX	UTMY	County	Sampled By	Water Temperature (degrees F)	Transparency (cm)	pH (pH units)	Nitrite-N (mg/L)	Nitrate-N (mg/L)	Dissolved Oxygen (mg/L)	Phosphorus (mg/L)	Chloride (mg/L)
1-1	Highway 20 - upstream	Main Channel	7/12/2015	593577	4700597	Buchanan	Robin Fortney, Jodi Kallevang	73	22	9	0	10	12	0	<31
1-2	Highway 20 - downstream	Main Channel	7/12/2015	593793	4699848	Buchanan	Robin Fortney, Jodi Kallevang	74	27	9	0	10	12	0.1	<31
1-3	Iron Bridge Woodland	Main Channel	7/12/2015	597666	4694906	Buchanan	Robin Fortney, Jodi Kallevang	75	29	9	0	10	12	0	<31
1-4	Pine Creek Wildlife Area	Tributary	7/12/2015	600635	4695571	Buchanan	Robin Fortney, Jodi Kallevang	70	60	9	0	10	12	0	<31
2-1	Wapsipinicon River	Main Channel	7/13/2015	609521	4682777	Linn	Mary and David Koester	75	20	9	0	10	12	0	<31
2-2	Unnamed Creek	Tributary	7/13/2015	610653	4681557	Linn	Mary and David Koester	70		9	0	10	8	0	
2-3	Unnamed Creek	Tributary	7/13/2015	614639	4677905	Linn	Mary and David Koester	68		9	0	10	8	0.2	<30
2-4	Unnamed Creek	Tributary	7/13/2015	616506	4678211	Linn	Mary and David Koester	76	60	9	0	10	8	0.2	<31
2-5	Walton Creek	Tributary	7/13/2015	617394	4678142	Linn	Mary and David Koester	80	24	9	0	5	8	0	<30
2-6	Justins Creek	Tributary	7/13/2015	618358	4676876	Linn	Mary and David Koester	77	12	9	0	10	6	0.2	<31
2-7	Unnamed Creek	Tile	7/13/2015	619819	4676093	Linn	Mary and David Koester	60	60	9	0	10	8	0.2	<30
2-8	Wapsinicon River	Main Channel	7/13/2015	620314	4674854	Linn	Mary and David Koester	82	25	9	0	10	12	0	<30
3-1	Unnamed Creek	Tributary	7/14/2015	623220	4670353	Linn	Teagan DiSalvo, Danilea McKee, Maas family	65	22	8	0	10	10	0.3	<31
3-2	Wapsipinicon River	Main Channel	7/14/2015	624351	4671191	Linn	Teagan DiSalvo, Danilea McKee, Maas family	78	23	7	0.15	10	12	0	<31
3-3	Unnamed Creek	Tributary	7/14/2015	631161	4666321	Linn	Teagan DiSalvo, Danilea McKee, Maas family	84	27	9	0	5	12	0.6	<31
3-4	Unnamed Creek	Tributary	7/14/2015	633263	4664839	Linn	Teagan DiSalvo, Danilea McKee, Maas family	78	60	9	0	1	10	0.1	50
4-1	Crow's Creek	Tributary	7/15/2015	635628	4664157	Jones	Chuck Tonelli and others	74	32	8	0	5	10	0.1	<31
4-2	Buffalo Creek	Tributary	7/15/2015	640519	4662612	Jones	Chuck Tonelli and others	73	60	9	0	5	10	0.1	<31
4-3	Dutch Creek	Tributary	7/15/2015	642591	4661562	Jones	Chuck Tonelli and others	74	30	9	0	2	10	0	31
4-4	Unnamed Creek	Tributary	7/15/2015	646197	4659341	Jones	Chuck Tonelli and others	77	25	9	0	5	8	0	<31
5-1	Wapsipinicon River	Main Channel	7/16/2015	650803	4657084	Jones	Chuck Tonelli and others	73	30	8	0	5	6	0	<31
5-2	Wapsipinicon River	Main Channel	7/16/2015	653476	4653049	Jones	Chuck Tonelli and others	73	27	8	0	10	8	0.1	<31